

Exhibit (ss measurement)

Guidance for Measuring Settled Solids in an Impoundment

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Introduction

The operation of wastewater and stormwater impoundments to store liquid that contains settleable suspended solids (such as dairy wastewater and stormwater) results in an accumulation of settled solids (sludge) on the bottom of the impoundments. This settled solids accumulation displaces the free-liquid capacity and thus reduces an impoundment's effective capacity, potentially resulting in a violation of the capacity requirements proposed in Section 20.6.2.3217.D. The accumulated settled solids contained in wastewater and stormwater impoundments characteristically include settled material such as; organic sludge from manure and inorganic sediment (primarily from dirt and grit). The material may exist in liquid, semi-solid, solid (hard solids) form and has a higher specific gravity than wastewater or stormwater in an impoundment (thus causing settling). Because this material is typically viscous (compared to wastewater or stormwater) and relatively particulate in nature, settled solids cannot be regularly transferred from an impoundment to a land application area without plugging irrigation equipment. Figure 1 shows a profile representation of how settled solids accumulate within a lagoon.

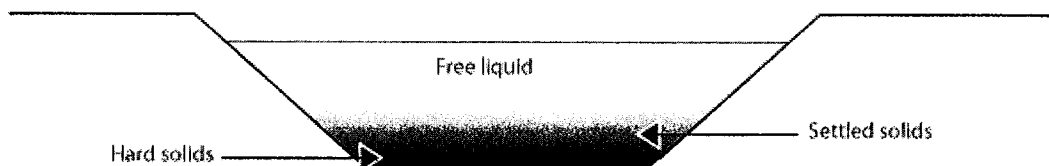


Figure 1 (settled solids within a lagoon)

Routine measurement of settled solids is necessary to understand the functional free-liquid capacity of an impoundment at a given time, as well as when planning for the removal and disposal of the accumulated material. Settled solids measurement, removal and disposal are standard practices at domestic wastewater treatment lagoon facilities and I have personally performed the types of measurements described herein at domestic wastewater treatment facilities throughout New Mexico. The same methods used to measure settleable solids in domestic wastewater facilities are applicable to dairy facilities when the aim is to use the measurements for the purpose of estimating the free-liquid capacity of an impoundment.

Settled Solids Measurement Methods

A number of methods exist for measuring the depth of settled solids in wastewater and stormwater impoundments. These include: simple probes, core sampling devices, electronic and non-electronic optical devices and electronic depth sounders. Some of these devices cannot deliver the needed accuracy, such as simple probes, and some are unnecessarily expensive, such

as infrared optical sensors. Of the available devices, the department supports the use of the core sampler for most situations because it is inexpensive, durable and sufficiently accurate under a wide number of conditions (i.e., shallow or deep settled solids levels, highly variable settled solids levels, most viscous sludges, etc.) encountered. However, the core sampler devices are only applicable for measuring settled solids in liquid depths less than 25 feet, because liquid cores greater than this make the instrument heavy and unwieldy. In cases where core samplers cannot be used, the department supports the use of electronic depth sounders that are capable of displaying settled solids down to the floor of the impoundment. All methods require the use of a small boat to gain access to the surface of the impoundment to obtain representative measurements.

A core sampler device consists of a length of clear tubing (1 – 2 inches in diameter) which is fitted with a ball check valve (known as a foot-valve) at the bottom end, and graduated depth markings (typically in one foot gradations) along the length of the tubing. The device must be long enough to reach to the bottom of the impoundment being measured, with at least one additional foot of tubing above the maximum waterline for handling. They are typically sold commercially in 5 and 10 foot lengths which can be connected together for a total length of up to 25 feet.

To use a core sampler, the device is inserted into the liquid to be measured vertically with the foot-valve down using a deliberate forward motion until significant resistance is encountered. Once the device cannot be inserted further, the device is “jiggled” up and down slightly, followed by a deliberate short, quick upward motion (jerk) as the device is withdrawn. This action “sets” the foot-valve, effectively trapping the “core” sample of the impoundment contents inside the device. The sampler is now withdrawn from the liquid and both the total liquid depth and the location of the liquid/settled solids interface are noted.

Typically, two individuals are involved in core sampler measurements of an impoundment; one to perform the measurement and one to handle the boat from which the measurements are made. Safety measures, including life jackets for both individuals in the boat, appropriate personal protective equipment (rubber gloves, etc.) and hygiene, should be observed.

Number of Measurements in Each Impoundment

When taking measurements with a core sampler, multiple measurements are necessary because accumulation is not uniform on the bottom of an impoundment. In fact, settled solids distribution is frequently noted to be mounded near the inlet, and to a lesser extent, outlet of an impoundment and/or in areas subject to poor mixing (see Exhibit X). To represent the settled solids accumulated throughout the entire impoundment, the department proposes dividing the impoundment into a grid of nine equal sub-areas such that measurements are taken at each sub-area. Nine measurements represent an acceptable sample size (if minimal), and is workable because a variety of impoundment shapes can be easily divided into nine relatively equal-sized areas, like a “tic-tac-toe” grid. The results of all nine sub-areas can then be averaged to determine the average settled solids depth in the impoundment.

Sources of Measurement Error

There are a few factors which can complicate measurements made with a core sampler, and these should be understood by the individual using the device. The sources of error, and considerations about how to avoid them, are categorized as follows:

1. Inaccurate sampling technique

If the user of the device fails to set the foot-valve properly, the core contents will be partially lost, starting with the settled solids first. This results in an inaccurate (reduced) measurement of the settled solids. By observing that the liquid level in the core sampler remains fixed as it is withdrawn, this type of error can be avoided.

If the core sampler is not inserted vertically, a diagonal core of the settled solids and free liquid will be obtained. This results in an inaccurate (increased) measurement of the settled solids. Ensuring vertical insertion of the core sampler avoids this error.

2. Solids/liquids interface difficult to discern

In some situations, the solids/liquid interface is difficult to discern because it exists as a gradual shift from the liquid column to the settled solids, rather than a distinct separation. In this case, the individual performing the method will have to employ judgment about where the settled solids cease and the liquid level begins. Because this uncertainty decreases the accuracy of the measurement, a conservative approach should be taken.

3. Accumulated solid material that cannot enter the core sampler

The accumulation of very heavy solids and grit on the bottom of an impoundment can result in significant resistance being encountered (similar to the resistance encountered when the core sampler is contacting the bottom of the impoundment) and a failure of the material to enter the core sampler, and thus a failure to measure this accumulated material. When these conditions are encountered, the foot-valve is often fouled and heavy grit will be observed at the foot-valve or in the bottom of the sampler. Establishing the depth of this heavy material can be difficult, and it must typically be extrapolated using the known depth of the impoundment and the maximum depth that the core sampler can be inserted. Record drawings of the impoundment are useful here.

Conclusion

With practice, an individual using a core sampler can accurately judge the accumulation of settled solids within an impoundment to an accuracy of $\pm 1/2$ ft. It is recognized that there are sources of inaccuracy with the core sampler measurement method; however the department contends that the accuracy level is sufficient for the purpose of estimating free-liquid capacity. Last, the method is basic and inexpensive enough to be employed at dairy facilities.